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Science and Art Gossip.

It has been said of Dr. Stokes, of Cambridge, that he has never made a mistake. We venture to add that "it is a pity." He would be regarded now as the inventor of the most important method of physical research ever invented —spectroscopic analysis—if he had not been so careful to avoid all possibility of mistake that he omitted to publish what he had discovered. He is as careful, it must be admitted, in dealing with other men's discoveries or theories. What seems absolutely certain from the evidence, he is apt to describe as "so far supported by the facts adduced that I am disposed to think it is not altogether unlikely to be true." In fact, Professor Stokes is a veritable "unbelieving Thomas" in matters scientific. It is currently reported that when he sees the sun shining in the heavens, he "admits as probable the theory that some time before the sun may have crossed the horizon."

The Victoria Institute, originally founded by Mr. Reddie (one of the paradoxists whom De Morgan trod out) for the support of religion against the evil ways of science, recently invited Dr. Stokes to read a paper before its members, on Modern Scientific Thought. In this he, "as a scientific man" (one would have thought he would only have "suggested as probable" the belief that he is a student of science), repudiated the idea that the progress of science would disprove the truth of revelation—a vague saying till it is explained what is meant by revelation. And he went on to say, that "God's Word and God's Work had never clashed." Surely he must have formed a strange idea of the capacity of his audience, to tell them *this*. If he had said Truth is Truth, or Truth never clashes with Truth, what would they have thought? Yet what he said signified "only this and nothing more."

He went on to say that "Darwin's theory of 'ancestral derivation and the survival of the fittest,' must rest mainly on the estimate which might be formed of its own probability," which really seems tolerably obvious. Only, it so happens that there is no "Darwin's theory of 'ancestral derivation or the survival of the fittest.'" Ancestral derivation is as old as the oldest literature known to man, and probably much older, and the survival of the fittest (Mr. Herbert Spencer's expression), is as obvious as the hills. Darwin's theory is that species may be, and have been, changed by natural selection, arising in the struggle for existence. Dr. Stokes seems little acquainted with what Darwin really taught, since he mistakes the foundation of Darwinism for the superstructure. It must be gratifying to those naturalists who are able to form a valid opinion on the question, to learn that the deservedly eminent physicist who would not publish his own really demonstrated theories, lest two and two should turn out unequal to four, considers "Darwinism, though highly ingenious as an hypothesis, very far indeed from being admissible to the rank of a well-established theory." Yet Dr. Stokes would, perhaps, "admit, as not altogether improbable," the theory that men who have given their whole lives to the study of natural history, and are not much readier than others to give more honour to a fellow-worker than he deserves, are, on the whole, more likely to form a just opinion of Darwinism than a highly-distinguished physicist, who appears to have taken but a superficial view of the subject. The greatest living English naturalists are now scarcely ready to waste time in defending either the general doctrine of biological evolution, or that special part of it which is associated with the name of Charles Darwin. The most eminent naturalists of the Continent and of America have long since "assumed the doctrine of evolution and gone on." It seems not altogether unlikely that they know what they are about in their own field of labour.

The severe storm which commenced yesterday week proved very disastrous to the inland telegraph system. Snow fell heavily in the north, and as a result telegraphic communication with towns north of Birmingham was almost stopped. Things grew worse as the day wore on, but in the evening, more moderate weather prevailing, there appeared a slightly better prospect. On Saturday night, however, the storm was again violent, and on Sunday night the gale attained an almost unprecedented force, and, telegraphically speaking, was felt much nearer home. The result, as may be supposed, was again calamitous, and notices of anticipated delay had to be issued by the postal authorities. On Monday night there appears to have been a resumption of the normal state of affairs.

Owing to its greater strength, phosphorus bronze is used sometimes instead of copper for conducting electricity, since much smaller wire possesses the necessary strength. The resistance offered by phosphorus bronze is considerably greater than that of copper, so that while it answers well for telephone wire it is not adapted to long telegraphic lines. L. Weiller, of Angoulême, has recently alloyed copper with silicon instead of phosphorus, and made a silicon bronze, the conductivity of which is twice that of phosphorus bronze, while its strength is not less, and hence seems well adapted to electric conductors. The relative strengths of copper, silico bronze, and phosphorus bronze are as 28, 70, and 90; conductivity as 100, 61, and 30.

The Reno, Nevada, *Gazette* describes a remarkable hill of moving sand in the eastern part of Churchill County, Nevada, about sixty miles from Land Springs Station. It is about four miles long and about a mile wide. In the whole dune, which is from 100 to 400 feet in height, and contains millions of tons of sand, it is impossible to find a particle larger than a pin head. It is so fine that if an ordinary barley sack be filled and placed in a moving

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waggon, the jolting of the vehicle would empty the sack, and yet it has no form of dust in it, and is as clean as any sea-beach sand. The mountain is so solid as to give it a musical sound when trod upon, and oftentimes a bird lighting on it, or a large lizard running across the bottom, will start a large quantity of the sand to sliding, which makes a noise resembling the vibration of telegraph wires with a hard wind blowing, but so much louder that it is often heard at a distance of six or seven miles, and it is deafening to a person standing within a short distance of the sliding sand. A peculiar feature of the dune is that it is not stationary, but rolls slowly eastward, the wind gathering it up on the west end, and carrying it along the ridge until it is again deposited at the eastern end. Mr. Monroe, the well-known surveyor, having heard of the rambling habits of this mammoth sand-heap, quite a number of years ago took a careful bearing of it while sectioning Government lands in that vicinity. Several years later he visited the place, and found that the dune had moved something over a mile.

In a letter to a friend in Boston, an officer of the United States steamer *Alaska* gives an account of a meteor which was seen from the ship on the evening of Dec. 12, 1882, a few minutes after sunset, in latitude 38° 21′, longitude 134° 7′. All at once a loud, rushing noise was heard, like that of a large rocket descending from the heavens with immense force and velocity. It proved to be a meteor, and when within ten degrees of the horizon, it exploded with much noise and flame, the fragments streaming down into the ocean like great sparks and sprays of fire. The most wonderful part of the phenomenon then followed, for at the point in the heavens where the meteor burst there appeared a figure shaped like an immense distaff, all aglow with a bluish light of intense brilliancy. It kept that form for perhaps two minutes, when it began to lengthen upward, and growing wavy and zigzag in outline, diminished in breadth until it became a fine, faint spiral line, and its upper end dissolving into gathering clouds. It remained for about ten minutes, when it began to fade, and finally disappeared.

The captain of the barque *Gemsbok* reported that on October 9, during a south-west gale and a thick snow squall, a ball of fire passed across the ship, injuring three seamen and breaking both gunwales, and ripping the planks from the stern of the starboard boat, and exploded about twenty yards from the ship with a loud report, sparks flying from it like rockets. There was no lightning or thunder at the time.

Railway extension has been attended with remarkable town growth in America, but few towns have been founded in a night. A curious history, however, involving such rapidity, attaches to the town of McGregor, in Texas, which is situate 150 miles west of Tyler, and twenty miles west of Waco. The site was selected as the crossing of the Gulf, Colorado, and Santa Fé, and the Texas and St. Louis Railroads, one day in September, 1881. The report spread, and by the next morning the place was staked out in town lots, with all the details of streets, squares, &c., which are generally the work of time on the part of surveyors. At the opening sale the lots were disposed of at the rate of one and a-half per minute. In the aggregate 442 lots, covering 300 acres, were sold, and the next two towns were started, one within two miles, and the other three miles distant. Shanties appeared on the prairies, moving with all speed on rollers towards McGregor, and by the second day twelve houses were under construction, while the owners camped round in tents. At the close of two months the town numbered 170 houses, with a population of 500 souls. A weekly paper called the *Plaindealer* appeared in the course of another month, and thirteen more new houses were built. The prospects of McGregor are said to be most encouraging. Last summer the railways carried away 15,000 bales from this thriving young town, and the railway authorities have begun to build a local freight and passenger depôt with transfer facilities.

How has it been that the monotremes have come to exist in a remote part of the world, not only quite without any existing ally (for we count the New Guinea species as an echidna), but without a trace having been found of any fossil relative? Are they to be regarded as the last survivors of a once very numerous and generally diffused kind of animal life, or as specimens of a small and comparatively modern local offshoot—a sport? Their peculiarities differ from the structure of all ordinary beasts in such a way as to approximate towards that found among different birds and reptiles; but to which of these do they approach the nearer? In a very interesting paper, read on Tuesday, the 16th, at the Zoological Society, Professor Lankester pointed out, as the result of a number of careful dissections, that the structure of the heart, and especially that of the valve of the right side of the duck-billed platypus, is (as Professor Owen sagaciously divined) bird-like, rather than (as Professors Huxley and Gegenbaur suspected) formed like that of crocodiles. The anatomical details on which this judgment rests are too technical for reproduction here; but, while the structure of the heart of the platypus is very bird-like, that of the echidna is less so, so that if in the latter a few perforations in a piece of membrane were to appear so as to reduce the fibrous membrane into fibrous cords, it would thereby clearly approximate to the form of the heart found in all other beasts. Thus, the platypus, by its innermost structure, only makes more and more plain that bird-like nature which its duck's bill caused its first observers to suspect.

This, from the *Chemist and Druggist*, may be useful in the shops and elsewhere:—"It is said that tar may be instantaneously removed from the hands by rubbing them with the outside of fresh orange or lemon peel, and wiping dry immediately. It is astonishing what a small piece will clean. The volatile oils in the skins dissolve the tar, so that it can be wiped off."

The ballet at the Princess's Theatre, Manchester, in which there are twenty-six ladies, has now been for the past month lit up with the small Swan lamp. Each lady carries a lamp in a small flower placed on her head, and at her side a small battery, the average weight of which is 1½ lb.

The Chester correspondent of the *Leeds Mercury* says:—"An important discovery has been made at Elm Colliery, Buckley, Flintshire. As some men were engaged at one of the levels worked by Messrs. Watkinson they struck upon spring mineral oil. They endeavoured to utilise the liquid, and they discovered that it gave a brilliant light, and at the same time produced less smoke than average oils. Another spring was discovered on the same level on a subsequent day. The supply from the wells is not, so far, copious, but it is sufficient to inspire the hope that a ne industry will spring up in North Wales.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

II.—THE BOILING OF WATER.

As this is one of the most rudimentary of the operations of cookery, and the most frequently performed, it naturally takes a first place in treating the subject.

Water is boiled in the kitchen for two distinct purposes, 1st, for the cooking of itself; 2nd, for the cooking of other things. A dissertation on the difference between raw water and cooked water may appear pedantic, but, as I shall presently show, it is considerable, very practical, and important.

The best way to study any physical subject is to examine it experimentally, but this is not always possible with every-day means. In this case, however, there is no difficulty.

Take a thin* glass vessel, such as a flask, or better, one of the "beakers," or thin tumbler-shaped vessels, so largely used in chemical laboratories; partially fill it with ordinary household water, and then place it over the flame of a spirit-lamp, or Bunsen's, or other smokeless gas-burner. Carefully watch the result, and the following will be observed:—First of all little bubbles will be formed, adhering to the sides of the glass, but ultimately rising to the surface, and there becoming dissipated by diffusion in the air.

This is not boiling, as may be proved by trying the temperature with the finger. What, then, is it?

It is the yielding back of the atmospheric gases which the water has dissolved or condensed within itself. These bubbles have been collected and by analysis proved to consist of oxygen, nitrogen, and carbonic acid, obtained from the air; but in the water they exist by no means in the same proportions as originally in the air, nor in constant proportions in different samples of water. I need not here go into the quantitative details of these proportions, nor the reasons of their variation, though they are very interesting subjects.

Proceeding with our investigation, we shall find that the bubbles continue to form and rise until the water becomes too hot for the finger to bear immersion. At about this stage something else begins to occur. Much larger bubbles, or rather blisters, are now formed on the bottom of the vessel, immediately over the flame, and they continually collapse into apparent nothingness. Even at this stage a thermometer immersed in the water will show that the boiling-point is not reached. As the temperature rises, these blisters rise higher and higher, become more and more nearly spherical, finally quite so, then detach themselves and rise towards the surface; but the first that make this venture perish in the attempt—they gradually collapse as they rise, and vanish before reaching the surface. The thermometer now shows that the boiling-point is nearly reached, but not quite. Presently the bubbles rise completely to the surface and break there. Now the water is boiling, and the thermometer stands at 212° Fahr. or 100° Cent.

With the aid of suitable apparatus it can be shown that the atmospheric gases above named continue to be given off along with the steam for a considerable time after the boiling has commenced; the complete removal of their last traces being a very difficult, if not an impossible, physical problem.

After a moderate period of boiling, however, we may practically regard the water as free from these gases. In this condition I venture to call it cooked water. Our experiment so far indicates one of the differences between cooked and raw water. The cooked water has been deprived of the atmospheric gases that the raw water contained. By cooling some of the cooked water and tasting it the difference of flavour is very perceptible; by no means improved, though it is quite possible to acquire a preference for this flat, tasteless liquid.

If a fish be placed in such cooked water it swims for awhile with its mouth at the surface of the water, for just there is a film that is reacquiring its charge of oxygen, &c., by absorbing it from the air; but this film is so thin and so poorly charged, that after a short struggle the fish dies for lack of oxygen in its blood, drowned as truly and completely as a living, breathing animal when immersed in any kind of water.

Spring water and river water that have passed through or over considerable distances in calcareous districts suffer another change in boiling. The origin and nature of this change may be shown by another experiment as follows:—Buy a pennyworth of lime-water from a druggist, and procure a small glass tube of about quill size, or the stem of a fresh tobacco pipe may be used. Half fill a small wine-glass with the lime-water, and blow through it by means of the tube or tobacco-pipe. Presently it will become turbid. Continue the blowing, and the turbidity will increase up to a certain degree of milkiness. go on blowing with "commendable perseverance," and an inversion of effect will follow; the turbidity diminishes, and at last the water becomes clear again.

The chemistry of this is simple enough. From the lungs a mixture of nitrogen, oxygen, and carbonic acid is exhaled. The carbonic acid combines with the soluble lime and forms a carbonate of lime which is insoluble in mere water. But this carbonate of lime is to a certain extent soluble in water saturated with carbonic acid, and such saturation is effected by the continuation of blowing.

Now take some of the lime-water that has been thus treated, place it in a clean glass flask, and boil it. After a short time the flask will be found incrusted with a thin film of something. This is the carbonate of lime, which has been thrown down again by the action of boiling in drawing off its solvent, the carbonic acid. This crust will effervesce if a little acid is added to it.

In this manner our tea-kettles, engine boilers, &c., become incrusted when fed with calcareous waters, and most waters are calcareous; those supplied to London, which is surrounded by chalk, are largely so. Thus the boiling or cooking of such water effects a removal of its mineral impurities more or less completely. Other waters contain such mineral matter as salts of sodium and potassium. These are not removable by mere boiling.

Usually we have no very strong motive for removing either these or the dissolved carbonate of lime, or the atmospheric gases from water, but there is another class of impurities of serious importance. These are the organic matters dissolved in all water that has run over land covered with vegetable growth, or, more especially, which has received contributions from sewers or any other form of house drainage. Such water supplies nutriment to those microscopic abominations, the *micrococci*, *bacili*, *bacteria*, &c., which are now shown to be connected with blood poisoning—possibly do the whole of the poisoning business. These little pests are harmless, and probably nutritious, when cooked, but in their raw and wriggling

* In applying heat to glass vessels, thickness is a source of weakness or liability to fracture, on account of the unequal expansion of the two sides, due to inequality of temperature, which, of course, increases with the thickness of the glass. Besides this, the thickness increases the leverage of the breaking strain.

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state are horribly prolific in the blood of people who are in certain states of what is called "receptivity." They (the bacteria, &c.) appear to be poisoned or somehow killed off by the digestive secretions of the blood of some people, and nourished luxuriantly in the blood of others. As nobody can be quite sure to which class he belongs, or may presently belong, or whether the water supplied to his household is free from blood poisoning organisms, cooked water is a safer beverage than raw water.

The requirement for this simple operation of cooking increases with the density of our population, which on reaching a certain degree renders the pollution of all water obtained from the ordinary sources almost inevitable.

Reflecting on this subject, I have been struck with a curious fact that has hitherto escaped notice, viz., that in the country which over all others combines a very large population with a very small allowance of cleanliness, the ordinary drink of the people is boiled water flavoured by an infusion of leaves. These people, the Chinese, seem, in fact, to have been the inventors of boiled water beverages. Judging from travellers' accounts of the state of the rivers, rivulets, and general drainage and irrigation arrangements of China, its population could scarcely have reached its present density if Chinamen were drinkers of raw instead of cooked water.

LEARNING LANGUAGES.

By Richard A. Proctor.

(*Continued from page* 498, *Vol. II.*)

My remarks on this subject have been interrupted for awhile, though by what is likely to increase the weight of what I have to say. I had supposed the books in the Hamiltonian system were no longer published. Readers of Knowledge will have learned from the advertising columns that, not only are they published, but that they are now cheaper than they were. I have been engaged during the last few weeks in examining a number of the works published by Messrs. Hodgson & Son and by Messrs. Simpkin, Marshall, & Co., on this system. I have also placed several of these works in the hands of various members of my own family, and have carefully noted their experience, and tested what they have learned. I shall have more to say on these special points later; here I only note that the results have been altogether favourable to the system.

In my last I had considered my own experience in learning Latin and Greek, for what I wanted of those languages,—viz., to read Latin and Greek books,—by the use of "translations." I am disposed to think that the efficiency of this way of learning a language depends a good deal on the learner. Not on his zeal and industry, which I take for granted. I am writing for those only who *want* to learn, and think it worth while to take some trouble to learn. The question is not whether they will be at the pains to learn, but how best they can direct their efforts. If a boy takes a "crib" merely to save himself trouble, he will not learn faster than his fellows—very likely will not learn as quickly. Thirty lines of Virgil got up with a crib in ten minutes will not advance a boy's knowledge of Latin so much as the same thirty lines carefully worked at with grammar and dictionary during an hour or more; and the time saved by the first process will be wasted, we may assume, or worse. But a boy or man who wants to learn Latin, and reads three or four pages of Virgil or Cicero with a translation, say in an hour, and then during, say the next half-hour, after going over it carefully, looks up in grammar and dictionary such matters as still remain not clear to him; then again reads through the whole passage to get its effect as a piece of poetry or oratory; has beyond all question learned much more about Latin construction, and advanced much more in mastery over the Latin language, than one who has given an hour and a half to the attempt to find out with dictionary and grammar only the meaning of some thirty or forty lines. He has had as good mental discipline as the latter, and has also learned much more about Virgil and Cicero.

But undoubtedly in such work as this the clever boy has a greater pull over the dull boy than by the grammar and dictionary method. In both cases the brighter learner goes ahead, but much more in the work which appeals throughout to the intelligence than in that which is in great part the same for the brightest as for the stupidest. A clever boy may look out fifty words in a dictionary while a dull one looks out only forty or forty-five, but the former will catch the force and meaning of fifty phrases, sayings, and idioms, while the other has barely understood the significance of half-a-dozen. The work is decidedly more intellectual than the grammar and dictionary work. Hence, perhaps, the reason why many masters object to it. A teacher cannot keep his class together over such work as he could when the drag of dictionary work was upon them all.

Yet the dullest gain by the change (granting the will to work); and that the brightest gain much more is no real reason for objecting to it so far as the learner is concerned, though it may introduce a difficulty which is troublesome enough, perhaps, to the teacher.

After all, though, we are considering here rather the learner who works by himself and for himself than one who is under class-room discipline. Schoolmasters have pointed out to me difficulties which I have no doubt are serious enough. They know well, and I know very little, the troubles of class-work. It has happened to me nearly all my life that all my best work has been done by myself. I scarcely learned anything about languages from teachers, and nothing whatever about mathematics from them, though I attended classes held by the ablest, and had one of the most eminent mathematicians at Cambridge as private tutor. This may render what I have said of little weight as regards school teaching—though I think there remains a good deal of truth in the objections I have advanced against the simply preposterous way in which Latin and Greek are presented to boys' minds in many of our school books. But for the student who simply wants to learn a language and is free from all class trammels, I am certain from my own experience that the avoidance of the drudgery of dictionary work, by using translations, is most desirable, and if time is an object, *essential*. The ordinary translations are useful for this purpose. But they are much more useful to the quick than the slow-minded. The Hamiltonian system, which I must next consider, is more useful to all, especially to those who work and reason rather slowly.

(*To be continued.*)

It is stated that in the North Atlantic, says the *Scientific American*, waves have been observed of 24 ft. and 30 ft. high, highest being 43 ft., mean 18 ft., in westerly gales. In the Pacific, 32 ft. is recorded; South Atlantic, 22 ft.; Cape Horn, 32 ft.; Mediterranean, 14½ ft.; German Ocean, 13½ ft.; and French sailors mention 36 ft. in the Bay of Biscay.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E., &c.

No. V.—SKULL AND SPINE.

ONE very perceptible difference between the lower and "back-boneless," or *Invertebrated* animals, and the "back-boned," or *Vertebrated* series, consists in the possession by the latter of hard internal parts, named the *skeleton*. Perhaps it would be more correct to say the *endo-skeleton*, or inner skeleton, for the plain reason that the backboned animals may, and often do, possess a very well-defined outer skeleton as well. We, ourselves, possess an outer skeleton in the form of our hairs, nails, and teeth. All of these parts are formed from and by the *skin-layers*, and possess no relationship with the bones forming the inner-skeleton. From the fishes to mammals (or quadrupeds), including man, an internal skeleton is present in some form or other. It may appear simply as a soft cellular rod, the *notochord*, lying along the back of the animal, and showing no apparent affinity to the skeleton as we know that structure in higher life. Such is the skeleton in the lowest fish, known as the *Lancelet*. Then, as in sharks, rays, &c., the skeleton may remain permanently in a gristly (or *cartilaginous*) condition; whilst finally, in most fishes (cod, salmon, &c.), it is composed of *bone*. We seem to see that the older fishes, or those which are first known in a fossil state, such as the sharks and ganoids, represent, in so far as their skeletons are concerned, an early condition of the modern and bony fishes. Bone, as we learned in our first paper, grows from cartilage or gristle; and it would thus seem as though in the growth of a single bone we see a moving picture of the development of skeletons in past time.

The "backboned" animals, or *Vertebrates*, as most readers know, number five classes. These are, firstly, fishes; secondly, amphibians (frogs, toads, newts, &c.), often confused with, thirdly, the reptiles; fourthly, birds; and fifthly, mammals. Man, I need hardly say, takes his zoological position at the head of the last-named class. Leaving out the lowest fishes, and some of the older types as well, we find that all vertebrates possess an internal bony framework, the skeleton, which, besides affording support for the soft parts, and for the attachment of muscles, also forms cavities (*e.g.*, the skull and chest) for the protection of important organs. It is true that, even in man's own class—not to speak of the fishes, reptiles, and birds—there are animals which may possess a well-developed outside skeleton. The armadillos of South America, the pangolins of Asia and Africa, the hedgehogs and porcupines, all present us with an outside skeleton of more or less complete character. But, in addition, all the backboned animals, from fish to man, evince a common type in the structure and build of their bony parts. We can discern in all, the *spine*, *vertebral column*, or *backbone*, which forms the main axis of the body, and which expands in front or above to form the skull. Then, secondly, we see the limbs and their skeleton attached to this main axis. So that it would be perfectly correct in the first instance to say that all vertebrated animals possess a skeleton which is divisible, firstly, into the trunk or *axis*, and, secondly, the *appendages* or limbs; and anatomists have accordingly come to speak of the *axial* skeleton and the *appendicular* skeleton, as representing a natural division of the bony belongings of the body.

The *spine* or *backbone* forms a very convenient starting-point for a study of the skeleton. It consists in man of thirty-three bones, each called a *vertebra*. Each vertebra is built on a plan similar to that seen in its neighbour-bones. One common plan thus runs throughout the elements of the spine. Each of the vertebræ consists of a solid part, called its *centrum* or *body;* and it is the series of "bodies," which, when arranged in due order, give solidity to the spine. From the body arise certain projections called *processes*. Above, there is an arch which ends in a process called the *spinous process*. It is the series of these latter processes we feel when we stroke a cat's back, or when we feel our own spine, as in the back of the neck, for example. Other (*transverse*) processes—for the attachment of muscles like the spinous processes—are given off at the sides of the vertebræ; and lastly there are projections (*articular processes*), by means of which each vertebra interlocks with its neighbours. But a very important observation is that which shows us that in reality the spine is a *hollow tube*. Each vertebra has an arch, as we have seen; that is, part of it forms a bridge. If we join a number of bridges together, we form a tunnel. In our bodies, then, the vertebræ, united end to end, form a tunnel, or continuous tube, within which the *spinal cord* or *spinal marrow*—the great main nerve-trunk of the body—lies. The hollow of the spine, moreover, is continued upwards into the inside of the skull; the brain and spinal marrow thus becoming continuous. If we look at the section of a sheep or ox, whose body the butcher has cleft in two lengthwise down the middle of the spine, we may see how a tube is formed by the spine, and how, within this tube, the spinal cord is lodged. In truth, the body of all vertebrate animals, from the fish to the man, consists of two parallel tubes. One tube is formed by the spine and skull, as we have seen, and contains the nervous system. The other tube is formed by the general walls of the body, ribs, etc., and contains the other organs (heart, lungs, digestive organs, etc.), of our frames.

In the spine of man there are in all thirty-three bones. If we tabulate them as follows, we may gain a clear idea of the composition of the spine:—

(1) Neck Vertebræ.....	7	in number.
(2) Back „	12	„
(3) Lumbar or Loins Vertebræ	5	„
(4) Sacrum	5	„
(5) Coccyx (or tail)	4	„
Total.....	33	

The first three regions, neck, back, and loins, are readily recognised. The *sacrum* is a part of the spine, consisting of a single bone, formed of five united vertebræ, and which is wedged in between the haunch-bones; whilst the *coccyx* is the rudimentary tail, composed of four small and degraded vertebræ. Man's spine is very short as compared with that of many other animals. A serpent, for example, has an extremely long backbone, consisting in some cases of over 400 vertebræ; and a spider-monkey may have more bones in his tail than man possesses in his entire spine. Man's spine exhibits a series of very beautiful curves. Its average length in the adult is about 28 inches, and its curves adapt it for the effective support of the weight of head and body. Certain curves are found in humanity alone. For example, it is only in the human spine that we find the vertebræ of the loins curved or convex forward. At birth, the spine is well-nigh straight, save for a slight concavity or hollowing forward in the back. But when the erect position begins to be assumed, as when the child is held upwards in the sitting posture, the neck-region begins to grow convex forwards, and the curving forwards in the loins also appears.

The *skull* was formerly regarded as merely a mass of

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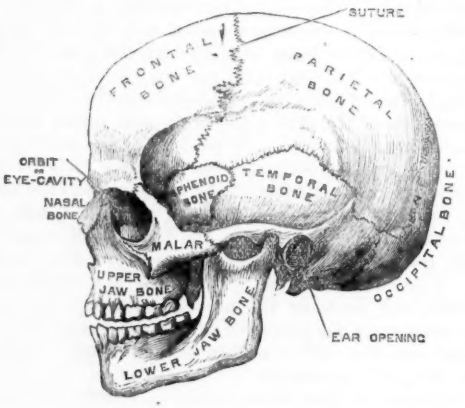
vertebræ peculiarly modified for their special position and functions. But we now know that the skull is developed in a different fashion from the spine; and that in its nature, it bears no such relationship to the backbone as that indicated above. We can divide any skull into (1) the *cranial part*, or "brain case;" and (2) the *face part*. In the human skull, which is a simple affair as compared with, say, the skull of a cod or crocodile, there are twenty-two bones. Eight of these form the brain-pan, and fourteen are found in the face. Firmly united together by dovetailing —or *sutures*, as the lines of union of the bones are called— the whole skull forms a beautifully firm case. The eight bones of the cranium are named as follows:—(1) the *occipital* (hinder bone of the head); (2 and 3) *parietals*, or side bones; (4 and 5) temporals; (6) *sphenoid* (in the middle of the floor); (7) the *frontal* (or forehead bone); (8) the *ethmoid* bone (front of the floor of the skull).



The face, with its fourteen bones, is constructed as follows:—(1 and 2) the *lachrymals* (forming part of the eye-cavities); (3 and 4) the *upper jaw bones* (united to form a single bone); (5 and 6) the *malars*, or cheek bones; (7 and 8) the *nasals*, or nose bones; (9 and 10) the *palate* bones; (11 and 12) the *inferior turbinal bones* (placed in the outer walls of the nose-cavities); (13) the *vomer*, or "ploughshare" bone (in the middle of the nose); (14) the *lower jaw*.

It is a decidedly human character to find, as we do in man, that the brain overhangs the face. In lower animals, and even in the most manlike apes, the brain retreats, and the face projects. In lower races of man there is a forward projection of the face, which is wanting in higher races. The lower types are therefore said to have *prognathous* (forward-jawed) skulls, whilst the higher races have *orthognathous* (or straight-jawed) skulls. The skull-openings are numerous. At the back of the base or floor, we see a very large hole in the occipital bone, called the *foramen magnum*. Through this aperture the brain and spinal cord become continuous. Then we find the ear-openings in the *temporal bones*, and the ear itself enclosed within the substance of these bones. The nostrils and eyes are also in pairs, and many openings exist for the passage of nerves from the brain outwards to the face and head at large.

In our next paper we shall conclude our review of the trunk, and also consider the skeleton of the limbs.

A few copies of Knowledge, Nos. 1, 4, 5, 6, 7, 8, 9, 10, 11 and 12, are for sale, price, post free, 6d. each. Apply or address, the Publishers, 75, Gt. Queen-street, London, W.C.

OPTICAL EFFECTS OF BELLADONNA.

By T. W. Webb.

THE following details of an experiment made by myself in 1870 may possibly be considered of sufficient interest to appear in the pages of Knowledge. They are copied from rough memoranda taken at the time:—

It should be premised that I am near sighted; the most perfect vision with my right eye (the better of the two) being attained (at that date) at eight or nine inches distance, but so far astigmatic as to be a trifle sharpened by the slightest possible pressure on the upper part of the ball. Into the other eye, which had less perfect definition, but a focus about one inch longer, on Oct. 6, towards night, I introduced a drop of the preparation of Belladonna known as "atropine." No effect was perceptible for ten minutes; after that time the pupil began to expand elliptically, and a candle was bordered by coloured fringes, brownish red, I believe, and blue. Before going to sleep I noticed with surprise that a faintly-lighted portion of the wall of my room seemed darker with that than with the other eye. Next morning the effect was fully attained. There was no pain or discomfort beyond a sensation as though my two eyes belonged to different people. Examination in the middle of the day showed that the pupil was elliptically enlarged to about four times the size of the other in one direction, three times in the opposite, the longer axis lying at about 20°, with a somewhat pear-shaped outline, narrowest towards the bottom; and perfectly clear. The focus was but little, if at all, changed; but vision was not sharp, and incapable of improvement by either of two concave lenses suited to different distances. Objects very near the eye are elongated; a circular ink-spot is lengthened towards 40°, and if very near acquires a bright orange interior; ink lines in any position are doubled, with an orange space between them; at ten or eleven inches the two images coalesce, and vision in a half-light is nearly normal, but still there is a kind of glare; and black writing appears rather blue. Further off the indistinctness increases; luminous objects are encompassed with puzzling rays; and a lady's chain in the light on a dark background is attended by three or four faint and indistinct images on either side. The general effect is that of a misty glare. Achromatism is also deranged in various ways. Near the eye white objects on a dark ground have an orange border, which at and beyond distinct vision changes to a nebulous blue tint; at greater distances becoming less marked or evanescent. White bodies do not seem to be reddened, but, especially in a strong light, every ruddy tint is deepened; the hands in particular acquire a pinker hue, the brown and yellow leaves of autumn become much redder, and scarlet geranium blossoms appear crimson. Blue, as of china, is paler, but not altered in tone. The general aspect of the landscape is not much affected excepting by haziness; in a moderate light objects seem to gain little, if at all, in brightness; it is otherwise with a glaring view, as of white clouds, or the landscape beneath the sun; but the increase of brightness is by no means in proportion to that of aperture. All dark objects seem viewed through a light nebulous mist. The other eye continued unaffected. In the evening there was some improvement; a candle near the eye is fuzzy; further away it is surrounded with an elliptic halo, blue within, brownish red without, enlarging with increasing distance, and not very symmetrical. Oct. 7. The pupil has rather diminished, but there is not much difference in the glare or false colouring, which, however, is now imperceptible in twilight or candlelight. All shadows are still grey rather than black. Oct. 8. Pupil still very elliptic and about three times too broad; the general mist and the

greyness of the shadows is improving, and there is no unusual colour; but lines nearer than distinct vision are still doubled. By Oct. 18 only a trace of enlargement remained; a very trifling ellipticity may, I believe, be the normal condition of the pupil.

Again, April 8, 1873, the other eye having accidentally received a slight touch of atropine, and a similar disturbance having ensued, the spectroscope was found to show some increase of intensity in the red, yellow, and yellow-green. But the most remarkable and unexpected, though, as it will be observed, not wholly unprecedented, result was the greater obscurity of everything in a faint light, such as that of a dark passage, the reverse of the effect in a strong one. Polarization produced no appreciable difference.

I may add that my eye is very tolerant of bright light. I have repeatedly in youth gazed directly at the sun; and once did so for a few moments with (I believe) a $3\frac{3}{4}$ inch achromatic at the Radcliffe Observatory (Oxford); but I should now think such experiments wrong, though they did not appear to produce any bad result. On the other hand, perhaps as a natural consequence, I am seldom successful in picking up very minute points of light.

According to Mr. Traill, the engineer of the Giant's Causeway and Portrush electric tramway, the total prime cost will be about £21,000 for six and a half miles of tramway, the cost of buildings, rolling stock, electric plant, engines, law, parliamentary, and engineering expenses. He says also that the electric car is able to ascend a long continuous hill of about one and a half miles in length, and with a gradient of 1 in 35, drawing a second car behind it, and work as readily and as well at a distance of two miles from the generator as adjacent to it.

The new ship canal proposed to be cut between the Baltic and the North Sea will save nearly 600 miles of the water journey now made around the Danish peninsula. The cut will be from Gluckstadt to Kiel, and the length will be about half that of the Suez Canal, or some fifty miles.

The *Overland Summary* (Calcutta, Dec. 26) says that the line of railway up to the Akoch side of the Indus has now been completed, and is ready for use. On the other side, the tunnel under the hill of Rajah Hoir has been bored through, and will soon be finished, while the bridge across the Indus is being rapidly proceeded with; so that it is hoped that trains will run to Peshawur without a break by May 1, 1883.

The total quantity of coal brought into London by railway and canal in December was 614,087 tons, against 618,889 tons last year. Of these 614,087 tons, the North-Western carried 140,123 tons; the Great Northern 88,676; Great Western, 113,032; Midland, 194,926; Great Eastern, 69,928; South-Western, 5,063; South-Eastern, 1,767; and the Grand Junction Canal, 570 tons.

A Curious Effect of Lightning.—At the Puy-de-Dôme Observatory, in France, some singular effects of lightning discharge have been noticed on the copper cups of a Robinson's anemometer mounted on the roof. The surface of the metal is curiously pitted, and from the centre of each pit rises a small cone or nipple of copper, smoothly polished, as if it had been turned in a lathe. These cones of fusion produced by the electric discharge remind one forcibly of the carbon points in an electric lamp, and indicate, as we have before remarked, a gyratory movement of the electric current.—*Engineering.*

HEALTH OF CORSETED WOMEN.*

By Dr. D. Lewis.

MANY physicians engaged in general practice have been asked what proportion of their practice comes of displacement of the pelvic viscera. Their average testimony is that more than half of their professional business comes of this one malady.

A letter just received from the most able specialist in the treatment of diseases of women known to the writer (a professor in a prominent medical college) contains the following language: "I am sure, without being able to demonstrate it, that 90 per cent. of the so-called female weaknesses have their origin in corsets and heavy skirts. They not only depress the pelvic organs by their pressure and weight, but weaken all of their normal efforts." A number of experienced practitioners in this department of medicine, hearing of the preparation of this paper, have written letters expressing the same decided opinion.

But may not a corset be worn so loose as to do no harm? If by a corset, a machine with steel, whalebones, or other stiffenings be meant, the answer is "No!" The corset is hard and stiff, while that portion of the body which it surrounds is particularly soft and flexible. If the wearer could always stand erect, with the corset so loose as not to touch her, no harm would be done. But she must sometimes sit, when the parts under the corset are greatly enlarged. Bending forward, as in sewing or reading, she leans against the upper ends of the whalebones, and then the pressure against the upper ends is returned against the abdomen at the lower end. If the wearer will put her hand under the lower end of her corset while she leans forward against the upper end, she will be surprised at the pressure. This pressure upon the abdomen, during all the long hours of sitting, does serious mischief. In one word, it may be added that, with every bending of the body, even the very loose corset is brought in contact with yielding parts. The floating ribs—that masterpiece of the human mechanism—and those soft parts of the person covered by the corset, cannot perform the undulating and vital movements incident to respiration and digestion, even under a very loose corset. Then what must we say of a corset which is not loose?

The corset does more than squeeze the waist. After forcing a considerable part of what belongs within the waist downward into a lower part of the abdomen, to prevent an unseemly protuberance, the corset is so contrived as to spread over all that lower part, force it down, and, with a firm layer of steel or whalebone, hold it there. This presses the abdominal viscera down upon the organs in the pelvis. Then, to end this tragedy with a farce, people put on serious faces, and wonder why women suffer from prolapsus uteri.

A numerous and busy class of medical specialists are devoted to the treatment of malpositions of the organs in the lower part of woman's abdomen. These malpositions are, directly and indirectly, the source of a large part of her ill-health and sufferings. Is it unreasonable to say that a pressure about the middle of the body, which reduces the waist from 3 to 15 in., must push what is within the waist downward, and must inevitably produce those malpositions of the organs at the bottom? Can a sane woman imagine any other result?

A girl who has indulged in tight lacing should not marry. She may be a very devoted wife, but her husband will secretly regret his marriage. Physicians of experience

* *North American Review.*

know what is meant, while thousands of husbands will not only know, but deeply feel the meaning of this hint.

[Dr. Lewis's closing words are specially addressed to his own nation, but they may be read with advantage here.]

One is led to say that the microscopic girls that swarm about our schools and chatter in our streets are the curiosities of what we call "high civilisation." They are found only among the lacing peoples. Wherever women give free play to their lungs and stomachs, they grow as large, or nearly as large, as men. This "high civilisation" is curious. Its avowed aim is a nobler manhood and womanhood. But while we are so proud of our telegraphs and railroads, and grand inventions, and magnificent improvements, and large corn-crops, that we run our printing-presses all night to proclaim our glory to the rising sun, our doctors, standing in the midst of a nation of men sucking tobacco, caution a nation of corseted women to go slow and lie flat on their backs three months every year.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—VII.

IN order to make the most of the tangent Galvanometer, a few resistance "blocks" or coils will be necessary. The wire most serviceable for this purpose will depend upon the current intended to be sent through it. When only a small resistance is required, it is in all cases best to use copper wire, but, for high resistances, German silver should be used, as the amount of copper required in such cases would be cumbersome. German silver compared to copper of the same length and sectional area, and at the same temperature, offering a relative resistance of about 13 to 1, considerable resistance can be introduced into a circuit by the use of thin wire of that metal. A "resistance-box" consists of a series of coils of wire offering various resistances, which can be inserted in or withdrawn from a circuit at pleasure, and with little or no trouble.

Resistance-boxes, or, as they are sometimes called, "Rheostats," are made in various forms, all more or less simple in appearance. Considerable mechanical skill is, however, necessary in the construction of most of them, because of the necessity that contact, where it is to be made, should be as perfect as the materials

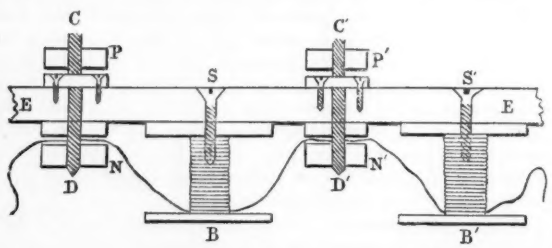


Fig. 1.

will permit. In the plan we are about to suggest, therefore, our object is to combine mechanical simplicity with electrical efficiency. A number of small bobbins (B, Fig. 1) of ebonite, ebony, or boxwood, are wound with wire sufficient to give their required resistances. Some little difficulty may possibly be encountered in measuring the resistance of the wire; but that is a branch of the subject the discussion of which we must reserve till our next article.*

In winding the coils, the wire, after being measured for resistance, should be doubled in the centre, from which the winding should be commenced.

If wound singly or continuously, the current, in passing through any given portion of the coil, induces in other portions opposing currents of electricity, which frequently prove very troublesome. This induction the method of double winding overcomes, as the current practically traverses two coils in opposite directions, in which the inductive effect is equal and opposite, neutrality being thereby produced. The bobbins are then fastened in rows by screws, or otherwise, on the under side of a sheet of ebonite or ebony, E E, about a quarter of an inch thick, the distance between the screws, S S, being about 1½ in. (The distance, is, however, quite immaterial, and is only governed by the dimensions of the bobbins, &c.) Between the bobbins, brass "binding-screws," C D, pass through the plate, E E to which they are screwed on the under or upper surface—the latter by preference. To the under portion of each binding-screw one of the extremities of each of the two adjacent coils is then screwed by means of the movable nut, N. Pieces of stout copper wire—or, better still, brass

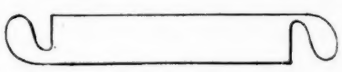


Fig. 2.

straps shaped as shown in Fig. 2—connect the upper portion of each binding-screw to the similar portion of those adjacent.

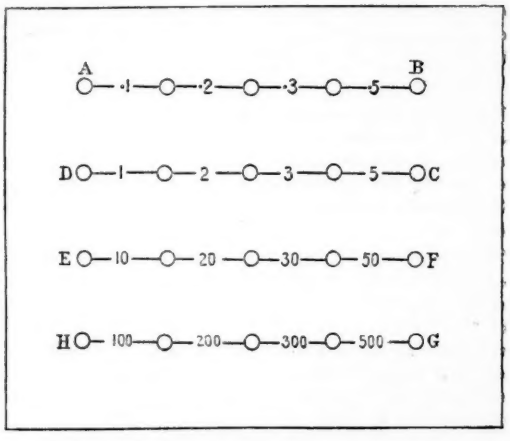


Fig. 3. (the figures in the last column should have been ·4, 4, 40, 400.)

Fig. 3 illustrates a device for sixteen coils, ranging in resistance from ·1 to 400 Ohms. The coils are arranged in four rows under the ebonite plate, which measures 9 in. by 7½ in. In the diagram, the circles represent the terminals or binding-screws, and the figures represent the resistance of the coil of wire connected to the adjacent terminals. Little paper or ivory labels may be fastened over the screw-heads (S Fig. 1), indicating the resistance offered by the subjacent coil. The ebonite plate becomes the top of a shallow box—say an inch in depth. In addition to the straps normally connecting the adjacent binding-

* Meanwhile, those of our readers who are unable to secure the use of a "standard" resistance coil are invited to send to "The Electrician," Knowledge Office, 74-76, Great Queen-street, W.C., short lengths (about two yards each) of about No. 35 B.W.G. copper wire and Nos. 24 and 35 German silver wire (all silk-covered). A stamped directed envelope being enclosed, the specimens will be measured and returned for use as standards of comparison.

screws on each row, a strap should also connect B to C, D to E, and F to G. A and H will then become the terminals to which the wires from other apparatus are connected. It is clear that with all the straps joined across, the current entering at A will pass through those straps to H, instead of passing through the coils, which the straps "cut-out" or "short-circuit." Suppose it is required to insert a resistance of 275 Ohms, then the straps over the 200, 40, 30, 3, and 2 Ohms resistance coils should be disconnected by loosening the screws at one extremity of each such strap and moving it out of contact. The current is then forced to pass through the coils enumerated. By disconnecting the side straps such as BC, we obviously break the circuit or introduce a resistance of "infinity," and by disconnecting all the three side straps, we can now use each row of coils in a separate circuit. This resistance-box, we shall find, is very useful for Wheatstone Bridge, and similar experiments.

NOVELTIES IN TRICYCLES.

By John Browning,

(*Treasurer of the London Tricycle Club.*)

THERE are sufficient novelties in the Stanley Show of Bicycles and Tricycles, which is held all this week at the Albert Hall, to ensure the success of half-a-dozen such exhibitions. Yet, the novelty is almost exclusively in tricycles, showing conclusively which way the tide is running. Only one novelty—a new kind of gearing—has been applied to a bicycle, and that is an after-thought. It was invented for the purpose of gearing tricycles up or down at pleasure, and it is called the Crypto-dynamic gearing; it gives to bicyclists a power they have never had before.

In this brief notice I cannot do much more than name the novelties, reserving my descriptions and criticisms for further articles which the editor of Knowledge has kindly asked me to write for him.

I would not in all cases wish it to be understood that I recommend everything I name on the score of novelty.

There is some amount of misplaced ingenuity, but for ingenuity well applied I would specially name the Sterling tricycle, by Adam Burdess. For moderately high speed, comfort, and safety, I think this open-fronted rear-steerer the best in the show. Next to it I would mention Rucker's improved rear-steering tricycles, though I only place them next because I consider Burdess's method of back pedalling to drive forwards gives a power of hill-mounting which cannot be obtained equally well in any other way.

First for speed I would name the new models of the Humber tricycle. For graceful appearance and exquisite workmanship they are almost unequalled. But, lest my numerous readers in Knowledge should suppose that I recommend this tricycle before all others for their adoption, let me remind them that comfort and safety ought to be studied when they select a tricycle, as much as speed and appearance. The so-named Ladies' Humber fairly combines all these conditions. It is as well adapted for gentlemen as ladies.

There is little room left for me to do more than mention the names of the leading novelties. I would direct attention, while there is yet time to inspect them, to the "Weston" tricycle, a new double-driver and front-steerer of excellent workmanship and admirably planned. The "Diana" tricycle, a double-driving front-steering machine, driven with balls on wire instead of a chain. This machine is geared so that it can be driven either as a 48″ or as a 35″, and it is a double-driver, with either gearing.

The "Orbicycle" is an excellent machine; a double-driver without a chain; but it is unnecessarily heavy.

The special Devon tricycle has a swing frame, which enables the rider to place himself at will at any angle of the machine, so that he can ride vertically with full power up-hill. W. Keen & Co. exhibit Kinnaird's patent action for bicycles and tricycles; a contrivance by which about 6″ throw in the crank can be used with less than 9″ rise and fall of the foot.

Singer & Co. exhibit the lightest and most compact Sociables for two riders, and also a most novel tricycle, in which the whole three wheels steer.

The whole of the exhibits were not in position while I was taking these notes. I may, therefore, have to name two or three novelties next week.

The *Zeitung des Vereins Deutscher Eisenbahn-Verwaltungen* (Berlin, Jan. 12) has received from its Russian correspondent the following details of the working of the Trans-Caucasian railway during the first half of 1882. This line, which is under the control of the Minister of War, carried the following Government traffic, of course without payment: 6,786 men, 1,135 tons of munitions of war, 12,535 tons of military and other stores, 586 horses, 109 transport, &c., waggons, and 13 head of cattle. The ordinary paid traffic for the same period amounted to 7,748 passengers, with about 19 tons of baggage, 4 vehicles, 38 horses, 2,659 head of cattle, and 1,818 tons of ordinary goods. The total receipts (including £732 received for conveyance of mails) amounted to £3,900. The writer remarks that there can be no question as to the working expenses exceeding the receipts by at least five times their amount.

The Study of Logic.—A question has been raised of late as to the value of the study of logic to improve the reasoning powers. If by the word logic is meant what is usually called formal logic, I venture to say—from an experience of my own—that the effect of such study is not good, that while it is in progress the reasoning powers are apt to deteriorate, and that in all probability they will be permanently diminished if the study of logic continues too long. I observed—and I find others have noted the same—that when much time had been given to the investigation and classification of the various forms of syllogism, the mind became apt to interrupt the reasoning process for one of classification, noting to what class any syllogism that presented itself belonged, rather than considering (what requires no logic to determine) whether the syllogism were sound or not. The effect might be compared to that of the careful explanation of the movements involved in rowing, skating, and swimming, in the case of one already able to row, skate, or swim fairly well. Such a one, in his anxiety to follow *seriatim* the movements explained to him, is very apt to perform them far less satisfactorily than he did when he went through them without thinking about them at all. As Macaulay remarks in his "Essay on Bacon," a sensible man reasons in *Barbara* and *Celarent* all day long without thinking about the matter. Set him to note carefully what he is doing, and you give his mind work to do which in no sense advances his reasoning. Few men have enough extra brain energy in them to go through this unnecessary mental work without disadvantage. But the study of the various lines of false reasoning into which most men are apt occasionally to fall, as arguing in a circle, forgetting the point at issue, or begging the question—this is at once useful and interesting.—Richard A. Proctor, in *Newcastle Weekly Chronicle.*

XUM

COMETS' TAILS.

HAVING read your admirable article in the *Contemporary Review* on Comets, I venture to offer to your readers a new theory on comets' tails [not altogether new. Bredichin's theory is similar; and in its general features the theory was suggested long since by Prof. Norton, of Yale (first), and by myself independently, later. —R. A. P.], which, I think, if worth nothing more, is at least as good as anything yet devised, and therefore equally worth demolition at your hands.

I venture to think that the repulsive force which acts is nothing more than that which, on a smaller scale, acts in a Crookes' radiometer. That space *is* more or less filled with greatly attenuated matter, many considerations will lead to. Only last issue of *Nature* contained an account of researches by Professor Aubrey, in which he claims to have discovered an absorption of radiation in the space between us and the sun, and to have traced this to the presence of hydro-carbons. Struve's researches on the distribution of the stars, showing that the stars of the lower magnitudes are less numerous than they should be, if stars were equally distributed in space and there were *no absorption of light*, points in the same direction. Again, what is to prevent the outer edges of all atmospheres flying off in the same form, as the unlimited expansibility of a gas would lead us to suppose? Here, then, we have *one* of the conditions in space that also exists in the glass bulb of the radiometer.

Next, I wish to show that any *very small* particles of solid matter would be strongly acted on by this repulsive tendency, and the more strongly the smaller they were. The conditions of repulsion are simply that the repelled side should be slightly warmer than the other; the radiation of the sun, so rapidly received, so rapidly parted with in the cold interstellar space, would ensure this.

Now let the repelled particles be *assumed* to be *spheres* —the worst possible shape for the hypothesis—and let the repulsive tendency per unit of surface directly exposed to the sun $=\phi$; then the repulsion on each particle will be $\phi\pi r^2$ (resolving the lines normal to the sun), and the attraction of gravitation will be $\frac{4}{3}g\rho\pi r^3$. Hence, the total action on the particle towards the sun will be $\pi r^2(\frac{3}{4}g\rho r - \phi)$. Now, the smaller the particle the smaller r will be, and, if small enough, this expression must have a minus value, and the total resultant action on the particle will be changed from attraction to a violent repulsion, within certain limits depending on the velocities of the molecules of the attenuated gas acting on the particle, as violent as we please by making r as small as we please. What, then, do I suppose? That the comet approaching the sun—stopping radiation—becomes, at its surface, lost; hence, the violent jets seen there, directly they get a certain distance from the heated surface, are condensed as fog, in small particles, and beaten back by this interstellar molecular "bombarding" action, into the shape of these envelopes—a line of envelope marking a line of equal temperature; but this envelope *itself* shuts in the heat within, and radiation out; and another envelope is formed within that—the edges of these envelopes sweeping back under the repulsive action to form the tail.

I conceive the successive striations in the tail to be "the winnowing out" of the different elements, according to size, &c., as you mention in the *Contemporary*.

Next, although I conceive the tail to be made up of small *particles*, probably solid, yet the spectroscopic observations would surely not deny this. The luminous clouds seen a few weeks back in conjunction with the aurora were probably made up of minute liquid or solid particles, and yet would most probably have given a spectrum of a few bright lines. [They did not, however.—Ed.]

Fred. F. Grensted.

THE WEATHER PROPHECIES.

I HAVE just read in Knowledge Sir Edmund Beckett's strictures on "Weather Prophecies," and agree with him as to the desirability of testing and recording the tests, though my observations do not accord with his. It is true that I have only made them when at the seaside, and exclusively in reference to the wind and the warnings. I have generally found the warnings correct, though often unpunctual, *i.e.*, the gale has come later than was expected.

On one occasion especially, sailing from London to Dublin, and calling at several places on the South Coast, we started from Cornwall in spite of the cone, the weather being exceptionally fine. We soon repented, and the captain, a man of much experience, stated that he had found the warnings generally reliable.

It would be interesting if, say, three independent observers in each of the districts named would make a similar record to that of Sir Edmund Beckett, and send these to Knowledge. The observer should write his notes of the day's weather *before reading the official prophecy*, and make no alteration afterwards, "*litera scripta manet.*" If on any day the three observers disagreed materially, the observation for that day should be erased as worthless. If two agreed closely and one was discrepant, the order of that day's record should be rated accordingly.

If some unprejudiced person would act as umpire, making the comparisons, and expressing numerically the weights pro and con, a general summary of the results might be so made as to express numerically the percentage of success and failure of the British clerks of the weather. My prophecy concerning the prophecies is that they will be found very successful as regards the wind, but doubtful otherwise. I have theoretical reasons for this anticipation, over and above the before-named experiences. These reasons I will explain if my prophecy prove correct. If wrong, like a true prophet, I will say no more about it.

W. Mattieu Williams.

The Electric Resistance of Glass. — Mr. G. Faussereau has been experimenting in this field, and says (in *Comptes Rendus*) :—For common glass, of specific gravity 2·539, expressing the resistances per cubic centimètre in millions of megohms, we obtain the following results :—

Temperatures.	Resistances.
+ 61·2° C.	0·705
+ 20	91·0
− 17	7970·0

To form an idea of the magnitude of this latter resistance we may remark that it represents about twice the resistance of a copper wire of one square millimètre in section, extending from the earth to Sirius. The resistance varies about by one-ninth of its value per degree of temperature. Hard glass of Bohemia, of specific gravity 2·431, is from ten to fifteen times *more* conductive than ordinary glass at the same temperatures. The crystal glass used has the specific gravity 2·933. It is 1,000 to 1,500 times *less* conductive than ordinary glass at the same temperatures. Its conductivity is only manifested above 40° C. At 46·2° C. its resistance = 6182; at 105° = 11·6.

CORPULENCE.*

NOTHING is more common than to hear stout people wish they were thinner, while not a few spare people wish for more adipose tissue. Much of this arises from man's nature not to be satisfied with things as they are; but some of this complaint rests on better grounds. There are certain disadvantages connected with carrying around an excessive quantity of useless fat. It is evident that the labour expended in carrying three hundred pounds of human flesh from place to place, or lifting it up a flight of stairs, is twice that required to handle one hundred and fifty pounds. The exertion being greater, the muscles should be stronger but, unfortunately they are usually weaker. All this weight must be borne by the same pair of feet, which frequently suffer from the strain, or are crushed by the superincumbent weight. An accumulation of fat about the trunk impedes respiration, and makes exercise almost impossible. For these and similar reasons that will readily occur to the reader, corpulent people are generally anxious to get rid of the excess. This is particularly the case with ladies of fashion, for "too much fat spoils the figure."

In the case of our domestic animals, we have it largely within our own control to say whether they shall be fat or thin. Every farmer knows how to fatten his cattle, and a fat horse is considered an index to the liberality of his feeder. Leaving out of account a few unhealthy individuals, most animals fatten when allowed to eat their fill and take their ease, but soon lose flesh when the feed is limited or bad.

In the human species, the rule fails as often as it holds good. Most lean men are notoriously large eaters, and some are, in addition, excessively lazy. Apparently all the conditions favourable to fattening are present, yet the individual remains spare and thin. Others attain great size on a limited diet of the poorest food. Nothing is more common than to see two individuals, a husband and wife, two brothers, or two sisters, living and working side by side, eating the same food, and drinking the same beverages, apparently taking an equal amount of exercise, yet one will weigh nearly twice as much as the other. The only explanation that has been offered for such cases, if both are in health, is that one is predisposed to *embonpoint*, the other not. No doubt the natural disposition, too, has a great influence; worry, rather than work, consumes the flesh, so that men who take the world easy frequently stay fat on the most limited diet.

The predisposing causes of corpulency, according to Immermann, are as follows:—1. *Heredity*, although it may not show itself until middle life. 2. *Period of life.* Nursing babies and people over forty are most inclined to be fat. *Sex;* the female is more inclined to be stout than the male. 4. *Physiological constitution;* full-blooded people throw up more fat than most thin-blooded ones, but there is a sort of anæmic condition that also favours corpulence. 5. *Temperament.* 6. *Genital anomalies;* we know that wethers, oxen, and capons, as well as eunuchs, are usually fat. Although the above-mentioned causes, which are beyond the control of the individual, favour corpulence, they do not produce it.

That a large number of corpulent persons are anxious to exchange their estate is shown by the large sale that "anti-fat" nostrums have, although their dangerous character is evident from the fact that at least one death has been traced to their use. It is not stated whether the victim, who had taken eighteen bottles of the medicine, had acquired the desired degree of tenuity before her death, but we infer that she had not, as she is spoken of as being "very stout." We conclude that "anti-fat" is not what it pretends to be, notwithstanding its dangerous character, and some authorities say that its chief ingredient is *fucus vesiculosus*, or tangle, a kind of seaweed, also used in some places to fatten hogs. If it really possesses any virtue, which is exceedingly doubtful, it is due to the iodine which it contains.

(To be continued.)

* From the *Scientific American.*

AN OPTICAL EXPERIMENT.

I HAVE recently been struck by the very beautiful experiment which can be made with an ordinary hand lens and a bucket of turbid water. If the lens be held near to the surface of the water (rain-water, after the grosser particles of soot have been deposited, answers very well), and exposed to a noon-day sun, the cone of light will track itself through the turbid water in the same manner as a beam of light through the dusty air of a darkened room. And now, supposing the lens *not* achromatic, and of short focus, there will be seen the effects of both the spherical and the chromatic aberration painted on the motes suspended in the water. The former shows itself as a central bright line, shooting somewhat beyond the apex of the cone formed by the rays from the marginal parts of the lens, as well as by the form of the caustic curve near the focus, when the rays cross to form the reversed cone. But it is the chromatic aberration which is most beautiful in this experiment. *Before* the crossing of the rays at the focus the cone of light is tinged with red, and *after* having crossed the colour is blue, the latter rays having passed from the inside to the outside of the cone. On intercepting the light at any point of its path through the water by a piece of white cardboard, both red and blue rays can be observed in their proper relative positions. After making the experiment, it is satisfactory to try the effect of an achromatic lens of about equal focal distance for comparison.

This suggests to me that a few papers from your pen on this very interesting subject of optics would be acceptable, perhaps, to a wider circle of readers than purely astronomical matter, which seems to be of limited interest. The number of optical instruments of various kinds in the hands of the public is now very large, and therefore illustrations and experiments drawn from the whole range of optical instruments should be of proportionate interest.—A. N. S.

A Toad's Cunning.—Charles White, of New Castle, has a brood of chickens which have the run of a portion of the yard, the old hen being kept shut up. The chickens are fed with moistened meal, in saucers, and when the dough gets a little sour it attracts large numbers of flies. An observant toad has evidently noticed this, and every day, towards evening, he makes his appearance in the yard, hops to a saucer, climbs in, and rolls over and over until he is covered with meal, having done which he awaits developments. The flies, enticed by the smell, soon swarm around the scheming batrachian, and whenever one passes within two inches or so of his nose, his tongue darts out and the fly disappears; and this plan works so well that the toad has taken it up as a regular business. The chickens do not manifest the least alarm at their clumsy and big-mouthed playmate, but seem to consider it quite a lark to gather around him and peck off his stolen meal, even when they have plenty more of the same sort in the saucers.—*New Hampshire Gazette.*

Reviews.

ELECTRIC ILLUMINATION.*

MR. DREDGE, one of the editors of our excellent contemporary *Engineering*, has accomplished a great task in amassing such an amount of valuable information as is to be found in the volume now before us. The greater part of it has already appeared in the pages of that journal; but the work involved in such a compilation brought up almost to the day of publication, cannot have been much diminished on that account.

In a well-pointed preface, the editor is careful to warn his readers against the twofold danger which must inevitably result from such an amount of speculation as has for some time been evinced by certain sections, viz., the risk ignorant and gullible men run of losing their money, and the reaction that must ensue, making all sections more or less timid, and so hampering further discoveries and inventions. "Possibly it will be found," says Mr. Dredge, "that no mode of electric lighting can be thoroughly adapted for domestic purposes until an efficient system of storage batteries has been devised." Here is to be found, we opine, the keystone to many a disaster that will, almost beyond doubt, be witnessed before many months have passed.

We are next reminded of the fact that forty years ago the attention of physicists was turned to electric lighting, and that many inventors have recorded ideas in the patent office, which "clash dangerously with some modern inventions." The history of the efforts to make electric lighting commercially successful is then briefly sketched, honourable names are mentioned which we rarely hear nowadays, and a useful preface is closed with an epitome of the work attempted in the succeeding 900 good-sized pages. The book is divided into four sections and an appendix. The first section, extending over eighty-seven pages, embraces five good chapters on "Electrical Units," "The Measurement of Electrical Intensity," "The Voltaic Arc," "The Mechanical Production of Electric Currents," and "The Theory of Dynamo-Electric Generators" respectively. The order of these chapters might, perhaps, have been modified with advantage, at least as regards that on "The Voltaic Arc," which occupies a somewhat isolated position. The chapter on Units is admirably written, the object being to convey to non-technical but intelligent minds a clear conception of the principles governing their value and significance. We notice, however, with regret, that the term "intensity" is introduced in a highly un-English, and we may add unscientific, manner. Those of our readers who have studied the subject for any lengthened period will doubtless remember that this term used to be applied in England in the same sense that we now use the term "electro-motive force." In France it has long been customary to speak of "intensity" where we used to speak of "quantity," or as we now say "current-strength." It is in fact the value "C" in the equation $C=\frac{E}{R}$. There is no excuse for such an intrusion, the only works in which the term is similarly applied being those translated from the French. The very word implies a property which many large currents do not possess. As an illustration we may cite the Edison dynamo, which, while it is capable of supplying sufficient electricity to illuminate a thousand incandescent lamps, has no effect whatever upon—the current cannot, in fact, pass through—a human being, while the smaller current from a Brush or any of the large dynamos for arc lighting, would and has produced instantaneous death. It would, therefore, have been preferable to let the word sink into oblivion rather than help to perpetuate so evident a misnomer. Apart from this, the chapter may be commended as the simplest and best we possess. The chapter on the voltaic arc is interesting in the highest degree, and serves, too, to show us how much we have yet to learn on the subject. Some trouble has been taken to gather all available information on the temperature of the arc, which, it has been said, approaches that of the sun. How varied are the figures! The highest computation for the carbon is 6,000° Cent., while Professor Rosetti gives much lower figures. The temperature of the sun is variously estimated, by Ericsson at between four and five million degs. Fahr., by Secchi at 250,000° Fahr., by Violle at not more than 2,500° Cent., and by Rosetti at 10,000° Cent., or 20,000° if allowance is made for the absorption of the solar atmosphere. The fourth and fifth chapters, in which we recognise a now familiar style, very ably deal with topics of the greatest importance to electricians, engineers, and the public at large. "Of the thousands who have heard that a steam-engine can provide us with electric currents, how many are there," asks the writer, "who comprehend the action of the generator or dynamo-electric machine? How many, of engineers even, can explain where the electricity comes from, or how the mechanical power is converted into electrical energy, or what the magnetism of the iron magnets has to do with it all?" How many, indeed! How many, may we add, who imagine that friction is the source of all the mighty power procured! The way in which the difficulties are gradually, progressively, and cleverly cleared away, is ingenious in the extreme.

The phraseology, however, is at times somewhat awkward—as, for example, on page 51 we read, "at first it lies horizontal with its plane very nearly along the lines of force, so that *almost none* of them pass through it." These, however, amid so many excellences are but slight and pardonable blemishes, and we should strongly advise every one who is interested in the subject, however expert or however ignorant he may be, to carefully peruse these two chapters, which close with an ingenious and well-explained theory concerning the "displacement of the brushes" of dynamo-machines and electric motors—a theory which may be calculated to charm away many troubles in the mind of the inquiring electrician.

Section 2 is devoted to "Magneto and Dynamo-electric Generators," and extends over 230 pages. Most of the matter has previously appeared in the columns of *Engineering*, but the collection of descriptions here given is of extreme utility, more especially to the engineer. The machines are treated historically, and every effort is made to present a complete account of all that has been done towards perfecting the dynamo. A perusal of this portion of the book cannot fail to convince one of the invalidity of the claims urged by numerous "inventors" of the present day. The matter is carefully written, the descriptions being both clear and complete.

Section 3 deals with conductors and carbons; the chapter on conductors containing a considerable amount of reliable information useful to the electrician and highly interesting to the general reader. The relative value of

* *Electric Illumination.* By Conrad Cooke, James Dredge, M. F. O'Reilly, S. P. Thompson, and H. Vivarez. Edited by James Dredge, with abstracts of specifications having reference to electric lighting, prepared by W. Lloyd Wise, Member of Council of Institute of Patent Agents. Vol. I. (London: Offices of *Engineering*.)

the different metals when used as conductors, and the efficiency of the different materials used for insulating purposes, are exhaustively dealt with; several other important questions being also considered. The adaptation of asbestos is referred to, but little is said about it, owing, doubtless, to the short experience so far obtained. It is, however, suggested, and we think rightly, that there appears to be a promising field for it. The authors, speaking of the manufacture of carbons, assert that "to give precise details of the mode of producing carbons, followed now by some of the principal makers, is out of the question, as the secret, if there be one, is jealously kept." A history is then given of the known processes, taken from M. Fontaine's "L'Eclairage Electrique," demonstrating how far in this branch of the subject the pioneers of electric lighting had advanced. So much, in fact, do they appear to have accomplished, that one marvels at the comparatively small progress since made. M. Carré, who may be regarded as one of the, if not *the*, principal manufacturer of electric carbons, has conducted a large number of experiments, and has been enabled by these means to deduce several important facts, of which he takes advantage in the process of manufacture. Referring to the Jablochkoff candle, we are informed that a foreman, storekeeper, and twenty-nine men are capable of producing an output of 5,000 candles per day, or 1,800,000 per annum.

Section 4 contains descriptions of the various forms of arc, semi-incandescent, and incandescent lamps. As in the other sections, an historical sketch precedes the description of the various modern forms, implying thereby a considerable expenditure of time and trouble. It is with great satisfaction that we find honour awarded to those to whom, in our opinion, it is justly due. "To whom in future years," says the writer, "will the honour of this revolution (in the application of electricity to lighting) be accorded? To no one person, certainly, but amongst the crowd of scientific workers, it is evident that a first place must be accorded to M. Gramme and M. Jablochkoff." The description of Edison's work is naturally a most important feature in the chapter on incandescent lamps, and a highly interesting account is given of the different phases in the history of his multitudinous patents. Edison's meters for measuring the amount of current supplied are fully described, and then follows a very elaborate statement of the claims of Edison and Swan to priority, an effort being made to demonstrate that Swan was first in the field, and more important still, that one of the chief claims of each of these two heroes (if we may be permitted so to style them) are absolutely diametrical, and neither of them essential. This closing section is certainly not the least interesting, and the book is completed by an extensive appendix, comprising abstracts of patents, &c.

The work is splendidly finished, printed in good clear type, on first-class paper, and contains upwards of eight hundred magnificent illustrations, such as we rarely see in English manuals. It teems with most valuable information to all who are interested in the subject, and it would be difficult to imagine a treatise of a more exhaustive and entertaining character. It appears at a most opportune moment, and will certainly do a great deal towards dispelling the doubts and difficulties of many engineers and others who will soon, if they do not already, perceive the necessity of possessing a knowledge of the principles and applications of the youngest of the sciences. A second volume is promised, and we look forward to it with considerable interest, anticipating that the two volumes will together constitute a standard manual of the highest order.

THE FACE OF THE SKY

From February 2nd to February 16th.

THE sun should be examined on every clear day for spots and faculæ.

Mercury is invisible. Venus, though very low down, is still a conspicuous object before sunrise.

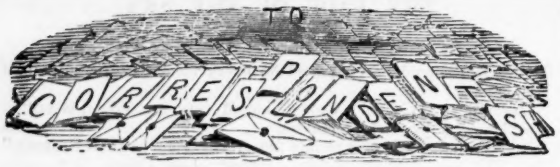
The constellations now visible (see "The Stars in their Seasons," Map II.) are Taurus, Gemini, Cancer, Leo, Orion, Monoceros, Pegasus, and Cetus, setting in the S.W. and W.; and Lyra and Cygnus doing the same in the N. and N.W.; Andromeda in the West too; Coma Berenices, Canes Venatici, and Böotes in the E. and N.E.; and Ursa Major to the E. of the zenith.

Saturn should be looked for as soon after dusk as possible, as he is rapidly approaching the west. He is still to be found to the S. and a little to the E. of δ Arietis. Jupiter is still the most conspicuous object in the night sky. He scarcely moves from his position to the W. and a little to the N. of ζ Tauri. His angular diameter is slowly diminishing, but this can hardly be detected without micrometrical measurement. The phenomena exhibited by his satellites, and visible at fairly convenient hours, are somewhat numerous during the next fourteen days. To-night (2nd) Satellite II. will be occulted at 7 h. 8 m., not to reappear from eclipse until 11 h. 52 m. 4 s. p.m.; nine minutes after midnight Satellite I. will enter on to Jupiter's face; the usual sequence of phenomena of it and its shadow happening during the earlier hours to-morrow morning. On the 3rd, Satellite I. will be occulted at 9 h. 19 m. p.m., and reappear from eclipse at 12 h. 35 m. 7s. p.m. The egress of the shadow of Satellite II. will happen at 6 h. 19m. p.m. on the 4th. This will be followed by the ingress of Satellite I. at 6 h. 36 m. At 7 h. 39 m. the shadow of Satellite I. will follow it on to Jupiter's face. Satellite I. itself will pass off at 8 h. 51 m., and its shadow at 9 h. 55 m. On the 5th, Satellite I. will reappear from eclipse at 7 h. 4 m. 5 s. The transit of Satellite III. will begin at 10 h. 58 m. p.m., and its egress happens at 1 h. 39 m. a.m. on the 6th. This should be carefully watched, for the reason given on page 42. On the 9th, Satellite III. will reappear from eclipse at 7 h. 52 m. 23 s. p.m., and Satellite II. will be occulted at 9h. 32m. An occultation of Satellite I. will happen at 11 h. 9 m. p.m. on the 10th. On the 11th the shadow of Satellite II. will enter on Jupiter's disc at 6 h. 11 m. p.m.; at 6 h. 41 m. the Satellite itself will pass off the opposite limb. The ingress of Satellite I. will occur at 8 h. 26 m., and the shadow of Satellite II. will leave Jupiter's face at 8 h. 57 m. The shadow of Satellite I. will begin to cross his disc at 9 h. 34 m.; the Satellite will pass off at 10 h. 41 m., followed by its shadow at 11 h. 50 m. On the 12th, I. will reappear from eclipse at 8 h. 59 m. 45 s. The egress of the shadow of this same Satellite will happen at 6 h. 19 m. p.m. on the 13th. If the student will sit up until the constellation Leo is well above the horizon, he may now obtain a telescopic view of the planet Uranus. As a guide to its position, he may draw a line from τ Leonis through a 6th magnitude star (89) to the left of it ("The Stars in their Seasons" Map II.), nearly on which line, and to the left of 89 again will be found the planet. It will be recognised at once by its pale blue disc, which will become more and more perceptibly marked with each increase of magnifying power.

The Moon does not rise until nearly 3 a.m. on the 2nd; and scarcely comes into view for the observer's purpose until the 9th, at noon, on which day she is 1·7 days old. On the 9th she travels from Aquarius into Pisces. She remains in Pisces during the whole of the 10th and 11th, passing on the 12th into Aries, out of which she does not pass until the 14th, when she moves into Taurus. She enters her first quarter at 9h. 55m. a.m. on this day. She does not quit Taurus during the 15th. The solitary occultation visible during the date comprised in our heading is that of the 5½ mag. star BAC, which disappears at the moon's dark limb, at an angle of 143° from her vertex,* at 10h. 5m. p.m., and reappears at her bright limb at 11h. 10m. p.m., at an angle of 288° from her vertex.

Health of Brighton.—According to the Registrar-General's report for the week ending Saturday last, Brighton occupies a conspicuously favourable position in the list of the twenty-eight large towns whose rates of mortality are periodically published. It comes first on the roll, with the very low mortality of 12·7 per 1,000 per annum, having a note appended that no death during the week was referable to any of the principal zymotic diseases. Leicester and Bristol follow Brighton, with rates of 16·1 and 16·4 respectively, while Hull, Sunderland, and Liverpool, at the other end of the list, present the formidable figures of 30·5, 30·6, and 31·1. The average mortality of the twenty-eight towns during the week was 22·4.—*Daily Telegraph.*

* See page 11.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

STINGING TREES.

[698]—It may be interesting to some of your readers to know that stinging trees are not confined to Australia alone. I have frequently seen them and felt them also in Kansas, U.S.

I can hardly describe them, though, as trees, never having seen them more than five or six feet high, yet they were quite distinct from weeds. They seemed to flourish principally in the vicinity of water, and we often came into contact with these unpleasant bushes after bathing in the streams. The sting was in the leaves, but by a remarkable arrangement of nature, these bushes appeared to be often infested with caterpillars, which ate the leaves off. At first, on running against the bushes, we thought that the caterpillars stung us in some way, but on experiment we found that it was the leaves themselves. The effects of the sting were very similar to bad mosquito bites.

I am sorry I cannot give you the Latin name, as I am not well versed in botany. Percy Elbutt.

Croydon, S.E.

STAYS AND STATUES.—WINTER RARITIES.

[699]—I note in your issue of January 12, a note to "Stays and Statues," in which you say you may perhaps omit much which you have written on the artistic aspect of the matter.

Please *don't*. Even if argument and evidence from statues, &c., has no force with "Observer," it most probably has with numbers of your readers who may profit by it, and you are not writing for "Observer" only.

I can supplement Mr. R. W. Smith's communication by stating that I yesterday saw an apparently perfect specimen of the peacock butterfly.

In our open garden here we have some snowdrops in full blossom.

W. Grandy.

CHIRPING SPIDER.

[700]—Can you, or any of your readers, tell me if there is a British chirping spider? I have long been perplexed, in the stillness of midnight, by a scratching, ticking, or chirping sound, repeated with great regularity from a dozen to perhaps fifty times in succession, apparently in the top of a low cupboard in the corner of my sitting-room. I had begun to suppose it either some very pertinacious wood-worm, or else the cooling and shrinking of the wall into which the cupboard is built after a fire in the next house had gone out; but this evening the door stood a little open, and the noise was louder. Quietly inserting a candle and my head, I found the chirping silenced, even without the candle. Any alteration of the light by the movement of my body in the doorway silenced the chirping. However, after a long, patient kneeling with my head in the dark cupboard, I heard the scratch, scratch, scratch, close to my ear. I withdrew, and it ceased. Returning with a match, I found my patience again rewarded. After very definitely locating the sound, I struck my match, and lo and behold! a small dense cobweb, consisting of a short tube above and two spreading arms below. As I brought the flame within two inches of the web, the chirping, which had been silenced by the match, broke out with three violent rapid notes, and I withdrew, fearing to disturb my guest. He has since been at it as heartily as ever. He has been there, I should say, at least a year. The cupboard is seldom opened—perhaps once a fortnight, but occasionally not at all for a month—so the supply of flies must be small. There were the remains of some insect in a corner of the web.

D. M.

ALTERATION IN COAST-LINE.

[701]—There are certainly some important and curious questions that might be raised as to past changes in the coast-line between the Welsh coast at the mouth of the Dee and the Ribble; but your correspondent, H'sett, in a letter in your number of Dec. 29 (No. 673), does not appear to me to offer any contribution towards sound conclusions on the subject, as he is incorrect in the facts from which he infers that "the sea has receded along the coast of Lancashire, from the Mersey almost to Preston." The ground on which he bases this conclusion is that "the whole country for miles is as flat as the proverbial pancake, and it can be at once seen that all this land, which is entirely made up of sand, must have been gradually formed by the retrocession of the sea." It is quite true that the country between the Mersey and the Ribble is flat, but it is not true that it is composed entirely, or even principally, of sand. It is mainly composed of peat—the sand is a mere fringe bounding the sea-coast, varying slightly in width, but nowhere much exceeding a mile, and in some places the sand has covered land formerly cultivated. There are, no doubt, changes taking place, as is usual in all flat coast-lines, and on part of the coast-line to the west of Southport the sand is certainly encroaching on the sea, and a new line of sand-hills is in process of formation outside the present line; but to the east of Southport there is no evidence of any such process going on, even if the reverse is not the case. There is, it is true, a sand-bank off the Southport coast, separated from the end of the pier by a deep channel; but it is quite incorrect to speak as if the outside of that bank were the coast-line. The sands off the coast from the mouth of the Dee to the mouth of the Ribble have changed much within living memory, but the changes are no doubt due to varying ocean currents, and not to the encroachment of the land on the sea; and Southport is certainly not at present more likely to become an inland town than it was fifty years ago.

A much more difficult and interesting question than the present changes in the sands is how to account for the remains of submarine forests in the estuary of the Mersey—a fact of which your correspondent is apparently not aware. A Southport Resident.

Our Mathematical Column.

A PRETTY PROBLEM.

A CORRESPONDENT ("Taranaki") some time since asked for a solution of the following problem, and we gave two solutions, both analytical. Another correspondent, "J. C. S.," gives the following very pretty geometrical solution:—

Theorem.—*If tangents* F P, F Q, *be drawn to a circle from* F, *the point of intersection of two opposite sides,* A B, D C, *of any quadrilateral,* A B C D, *inscribed in it, the points of contact,* P, Q, *lie on the line* E G, *joining* G, *the intersection of the diagonals, and* E, *the intersection of the other two sides of the quadrilateral.*

Let E G intersect A B, C D in H, K. Through H draw a line parallel to C D, meeting the diagonals A C, B D in p, q, and the sides A D, B C in r, s. We have then the following equalities of ratios:—

$$\frac{CK}{DK}=\frac{Hs}{Hr}=\frac{Hp}{Hq} \text{ and } \frac{DF}{CF}=\frac{Hr}{Hp}=\frac{Hq}{Hs}$$

By multiplication, $\frac{CK.DF}{DK.CF}=\frac{Hs}{Hp}=\frac{Hp}{Hs}$

Hence, $CK.DF=DK.CF$, and $\frac{CK}{DK}=\frac{CF}{DF}$

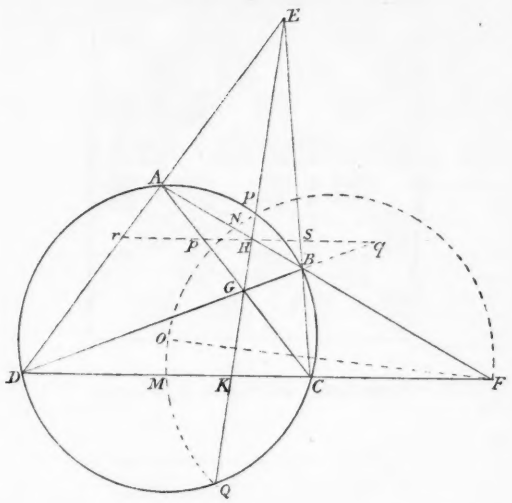
If M be the middle point of C D, then $\frac{CK}{DK}=\frac{CF}{DF}$ may be written

$$\frac{MC-MK}{MC+MK}=\frac{MF-MC}{MF+MC}$$

Hence, $\frac{MC}{MK}=\frac{MF}{MC}$ and $MK.MF=\overline{MC}^2$

But, by Euclid II. 3, $\overline{MK.MF} = \overline{MK.KF} + \overline{MK^2}$, and by II. 5, $\overline{MC^2} = \overline{DK.KC} + \overline{MK^2}$

$\therefore MK.KF = DK.KC$



Now, if A B C D be inscribed in a circle whose centre is O, and which cuts E G in P, Q, we have (Euclid III. 35) $DK.KC = PK.KQ$. $\therefore MK.KF = PK.KQ$, and a circle drawn through F, P, Q, will pass through M. In the same manner it may be shown to pass through N, the middle point of A B. But the circle described upon F O as diameter passes through M, N, since O M F and O N F are right angles. And as only one circle can pass through the three points F, M, N, it follows that P, Q lie on the circle who diameter is F O. Therefore, O P F, O Q F are right angles, and P, Q are the points of contact of the tangent from F. Q.E.D.

[NOTE. —The theorem is easily shown to be true for any conic section, for the circle O may be projected so as to become any given conic on another plane, and the lines P B A, P C D (which are quite arbitrary) may be so taken as to be projected from the same centre upon any given pair of lines cutting the conic. Then all the lines and points of contact and intersection in the two figures will necessarily correspond each to each.]—J. C. S.

ERRATUM.—At p. 60, col. 2, l. 14 from bottom, for *b* G.G A read B G.G A.

Our Whist Column.

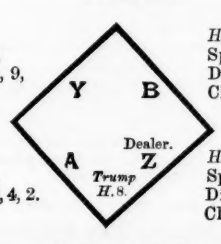
BY "FIVE OF CLUBS."

WE give this week one of the finest hands at Whist ever played. *Z* was Cavendish, and the game is number XXXVIII. in his book. We shall have some more notes and general remarks to make on this well-played *partie* next week.

THE HANDS.

Y.
Hearts—5, 4.
Spades—A, Kn, 6.
Diamonds—Q, Kn, 9, 8, 5.
Clubs—4, 3, 2.

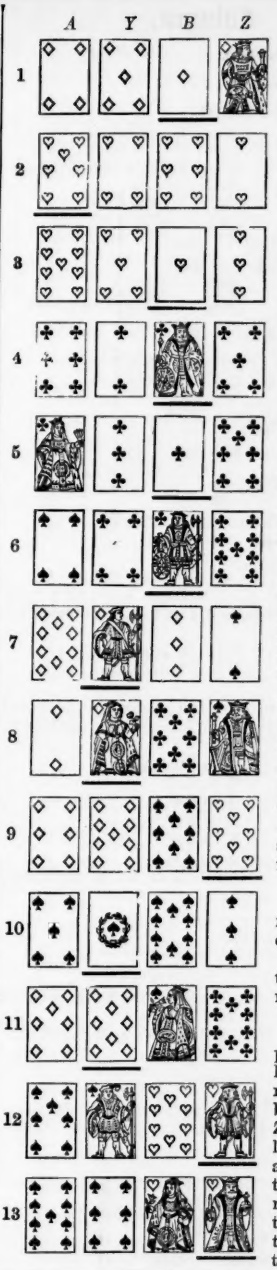
A.
Hearts—9, 7.
Spades—9, 7, 5, 4.
Diamonds—10, 7, 6, 4, 2.
Clubs—Q, 6.



B.
Hearts—A, Q, 10, 6.
Spades—Q, 10, 8.
Diamonds—A, 3.
Clubs—A, K, Kn, 8.

Z.
Hearts—K, Kn, 8, 3, 2.
Spades—K, 3, 2.
Diamonds—K.
Clubs—10, 9, 7, 5.

Score.—Four all.



NOTES AND REMARKS.

NOTE.—The card underlined wins the trick, and card below leads next round.

1. *A* leads penultimate of his long suit. Queen lies with *Y*; Three with *B*, unless *Y* is signalling (*A* alone knows this). *Z* has probably no more.

2. *B* knows that probably *Z* has no more Diamonds, while the Two has not appeared. But there is a strong probability that *A* has led from a five-card suit (since ten Diamonds lie between *A* and *Y*). It is, therefore, not likely that *Y* has begun a signal. Of course, *Z* may be signalling from King, Queen, but it is unlikely.

3. We doubt whether *A* should have returned his partner's lead of trumps. Strength in trumps is manifestly divided between *B* and *Z*, and very great strength, for nine trumps lie in these two hands. *A* knows, therefore, that though *B* may have been strong enough to lead trumps, *Z* may be stronger. *A* puts *B* in a bad position by returning trumps. *A* would have done better to lead Club Queen, in the hope that *B* may be strong in Clubs. This would have won: though that proves nothing. Two tricks were already made. Three more would have been made in Clubs. *A* would have made the sixth trick by ruffing Clubs; and the Ace of trumps would have won the odd trick and the game. After trick three, as played, *B* knows that *Y* has no more trumps, nor *A* (note the trump card). *Z* knows, also, that neither *A* nor *Y* have any more trumps.

4. *B* wisely gives up trumps.

5. After this *B* knows the fourth round in Clubs must go to the enemy.

6. *A* and *B* now want only one trick to win, and it looks as if they must get it.

7. *B* leads A's suit.

8. Very good play by *Z*. The position is plain enough, though how many Whist players fail to recognise such things. The second best trump lies with *B*, so that if *Z* has to lead trumps, *Y Z* *must* lose. The King of Spades is absolutely useless to *Z*, for if he takes a trick with it, the enemy must make a trick in trumps and the game. If *A B* have the Ace, the game is gone any way. If *Y* has the Ace and wins the King with it, *Y Z* may still win; but how apt *Y* would be *not* to win his partner's King! Therefore, to simplify his partner's play as much as possible, to "leave no point of strategy to partner to which he can attend himself," *Z* throws away his useless King.

9. But now another danger lurks in store for *Z* and his partner. *Z* has got rid of one winning card too many, but he still has another, his third trump. If *Y* make the ninth trick, *Z* must win the tenth or eleventh trick (it matters not which) and lose the game. Therefore, *Z* plays the *grand coup*: he trumps his partner's winning Diamond.

10 leads losing Spade, and thus enables his partner, after winning trick eleven,—

12 to lead up to *Z*'s tenace, giving *Y Z* the odd trick and the game.

ERRATUM.—Whist game, p. 15, last two tricks, interchange C 10 and D 9.

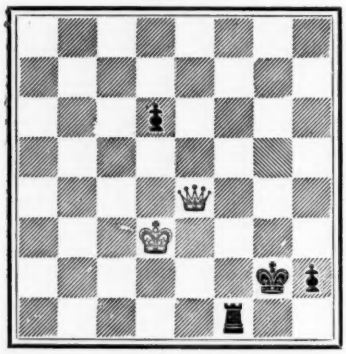
Our Chess Column.

By Mephisto.

END GAME STUDY.

Amateur.

Black.



White.

Mephisto.

This position occurred in actual play, and will serve as a good illustration of the danger of Queening a Pawn on the Rook's file if the adversary's King is too near.

	R to B6 (ch)
K to K2	P to R8 (Queen's)
Q takes R (ch)	K to R7

By carefully selecting checks, so that the Black Queen should not have a chance of coming into play, White is now enabled to force a mate as follows:—

Q to B4 (ch)	K to R6 (best)
Q to R6 (ch)	K to Kt7
Q to Kt5 (ch)	K to R6
Q to R5 (ch)	K to Kt7
Q to Kt4 (ch)	K to R7

K to B2 and wins (mate in three).

Black, however, need not interpose the Rook on B6, in which case the game would result in a draw.

SOLUTION.

Problem No. 71, by C. Planck, p. 46.

1. Kt to Kt5 — 1. P or R takes Kt or K to Q6
2. Q to B2 mate.

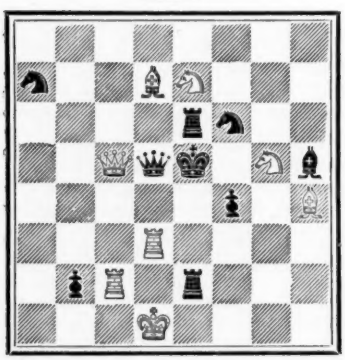
if 1. K takes Kt or B to Q6

2. KKt to Q6 mate.

PROBLEM No. 72.

By John Simpson.

Black.



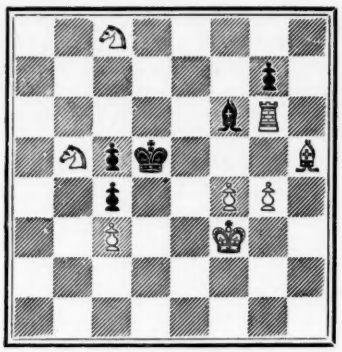
White.

White to play and mate in three moves; also White to play and compel Black to mate him (sui-mate) in three moves.

PROBLEM No. 73.

By Sidney Spokes.

Black.



White.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Zulu.—Write to the author at the Birmingham Chess Club.

Alfred B. Palmer.—You would be better able to see the point if you play over Black's game, you having the White men opposite to you, then you will see that his sixth move is Kt to K5; whether there is a Pawn on K5 or not cannot make any difference. It is, however, by no means an obvious interpretation of the move. The mistake will occur to many more players. It would not have admitted of any doubt had Black announced his move as 6. KKt takes P.

W. F. W. R.—In No. 67 (second solution) if 2. K to Kt3, 3. B to K4 mate.

J. Adamson.—The author's solution of Problem No. 70 was 1. Kt to Kt3 (ch), R or P takes Kt. 2. B to B4 and mate next move.

W. Mead.—Best thanks for game.

Correct solutions received.—Problem No. 71: W. R. Edwards, J. Birkett, H. A. N., W. F. W. R., M. T. H. Prize Problem: W., R. J. P.

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